CLAIMS

1. Apparatus for optical inspection, comprising:

a source of optical radiation, which is adapted to scan a spot of the radiation over a sample, whereby the radiation is scattered from the spot;

a detection system, comprising at least first and second detectors optically coupled to receive the scattered radiation and to generate respective first and second outputs responsive thereto, the detection system being configured so that the first detector detects variations in the scattered radiation with a greater sensitivity than the second detector, while the second detector saturates at a higher intensity of the scattered radiation than does the first detector; and

a signal processor, coupled to receive the first and second outputs and to determine, responsive to the outputs, locations of defects on the sample.

2. Apparatus according to claim 1, wherein the first and second detectors have respective first and second dynamic ranges, and wherein the signal processor is adapted to process the first and second outputs so as to generate an combined output having a third dynamic range, greater than the first and second dynamic ranges, for use in determining the locations of the defects.

3. Apparatus according to claim 2, wherein the signal processor is adapted to generate the combined output as a weighted sum of the first and second outputs.

4. Apparatus according to claim 2, wherein the signal processor is adapted to generate the combined output by selecting, at each point as the spot is scanned over the sample, a value of one of the first and second outputs.

5. Apparatus according to claim 2, wherein the detection system comprises an optical switch, which is adapted to direct the scattered radiation toward either of the first and second detectors in turn, and wherein the signal processor is coupled to drive the switch so as to select, at each point as the spot is scanned over the sample, one of the detectors to which the scattered radiation is to be directed.

6. Apparatus according to claim 2, wherein the first and second detectors are characterized by respective gains, which are selected so that the sensitivity of the combined output is shot-noise limited.

7. Apparatus according to claim 1, wherein the signal processor is coupled to process each of the first and second outputs to generate respective first and second defect maps, and to combine the first and second defect maps to determine the locations of the defects on the sample.

8. Apparatus according to claim 1, wherein the first and second detectors are configured to generate the first and second outputs with respective first and second gains, relative to the intensity of the scattered radiation incident thereon, and wherein the first gain is substantially greater than the second gain.

9. Apparatus according to claim 8, wherein the first detector comprises one of a photomultiplier tube and an avalanche photodiode, while the second detector comprises a PIN photodiode.

10. Apparatus according to claim 1, wherein the detection system comprises a beamsplitter, which is

positioned to split the scattered radiation between the first and second detectors.

11. Apparatus according to claim 10, wherein the beamsplitter is configured to direct a greater portion of the scattered radiation toward the first detector than toward the second detector.

12. Apparatus according to claim 1, wherein the detection system comprises a diffraction grating, which is positioned to intercept the scattered radiation and to diffract one order of the scattered radiation toward the first detector, and another order of the scattered radiation toward the second detector.

13. Apparatus according to claim 1, wherein the detection system comprises an optical element that is adapted to divide the scattered radiation between the first and second detectors in a manner that is substantially independent of a scattering angle and a polarization of the scattered radiation.

14. Apparatus according to claim 13, wherein the optical element comprises an integrating sphere, having an entrance port that is coupled to receive the scattered radiation, and first and second exit ports that are coupled to convey the scattered radiation to the first and second detectors, respectively.

15. Apparatus according to claim 14, wherein the first exit port is substantially larger than the second exit port.

16. Apparatus according to claim 1, wherein the detection system comprises at least one spatial filter, which is configured to block a portion of the scattered

radiation from reaching the first and second detectors, so as to facilitate detection of the radiation that is scattered from the defects.

17. Apparatus according to claim 16, wherein the at least one spatial filter comprises first and second spatial filters, which are respectively positioned so that the first spatial filter filters the scattered radiation reaching the first detector, while the second spatial filter filters the scattered radiation reaching the second detector.

18. Apparatus according to claim 17, wherein the signal processor is coupled to independently control each of the first and second spatial filters, so as to alter the portion of the scattered radiation that is blocked by each of the spatial filters.

19. Apparatus according to claim 1, wherein the detection comprises at least one attenuator, which is controllable so as to adjust an intensity of the scattered radiation that reaches at least one of the first and second detectors.

20. Apparatus according to claim 1, and comprising a third detector, optically coupled to receive the scattered radiation and to generate a third output responsive thereto, wherein the sensitivity of the third detector is intermediate the sensitivity of the first and second detectors, and wherein the signal processor is coupled to receive the third output and to determine the locations of the defects responsive to the third output, together with the first and second outputs.

21. Apparatus according to claim 1, wherein the optical radiation comprises coherent radiation, and wherein the detection system is configured so that the detectors receive the scattered radiation in a dark-field mode.

22. Apparatus according to claim 21, wherein the sample comprises a semiconductor wafer on which a pattern is formed, and wherein the signal processor is adapted to map the locations of the defects in the pattern.

23. An integrating sphere, comprising:

an inlet port, adapted to receive radiation;

a spherical body, having an internal surface that is adapted to diffusely reflect the radiation received through the inlet port; and

first and second output ports, adapted to convey the radiation from within the spherical body to first and second detectors, coupled respectively to the ports, the first port having a substantially greater diameter than the second port, whereby a substantially greater portion of the radiation is conveyed to the first detector than to the second detector.

24. A method for optical inspection, comprising:

scanning a spot of the radiation over a sample, whereby the radiation is scattered from the spot;

configuring at least first and second detectors so that the first detector detects variations in the scattered radiation with a greater sensitivity than the second detector, while the second detector saturates at a higher intensity of the scattered radiation than does the first detector;

detecting the scattered radiation using at least the first and second detectors so as to generate respective first and second outputs responsive thereto; and

processing at least the first and second outputs to determine locations of defects on the sample.

25. A method according to claim 24, wherein the first and second detectors have respective first and second dynamic ranges, and wherein processing at least the first and second outputs comprises generating an combined output having a third dynamic range, greater than the first and second dynamic ranges, for use in determining the locations of the defects.

26. A method according to claim 25, wherein generating the combined output comprises computing a weighted sum of the first and second outputs.

27. A method according to claim 25, wherein generating the combined output comprises selecting, at each point as the spot is scanned over the sample, a value of one of the first and second outputs.

28. A method according to claim 25, wherein detecting the scattered radiation comprises optically switching the scattered radiation between the first and second detectors as the spot is scanned over the sample, and wherein generating the combined output comprises receiving the output from the detector to which the scattered radiation is directed.

29. A method according to claim 25, wherein the first and second detectors are characterized by respective gains, and wherein configuring at least the first and

second detectors comprises setting the gains so that the sensitivity of the combined output is shot-noise limited.

30. A method according to claim 24, wherein processing at least the first and second outputs comprises processing each of the first and second outputs to generate respective first and second defect maps, and combining the first and second defect maps to determine the locations of the defects on the sample.

31. A method according to claim 24, wherein configuring at least the first and second detectors comprises configuring the detectors to generate the first and second outputs with respective first and second gains, relative to the intensity of the scattered radiation incident thereon, and wherein the first gain is substantially greater than the second gain.

32. A method according to claim 31, wherein the first detector comprises one of a photomultiplier tube and an avalanche photodiode, while the second detector comprises a PIN photodiode.

33. A method according to claim 24, wherein configuring at least the first and second detectors comprises splitting the scattered radiation between the first and second detectors.

34. A method according to claim 33, wherein splitting the scattered radiation comprises directing a greater portion of the scattered radiation toward the first detector than toward the second detector.

35. A method according to claim 33, wherein splitting the scattered radiation comprises positioning a diffraction grating to intercept the scattered radiation

and to diffract one order of the scattered radiation toward the first detector, and another order of the scattered radiation toward the second detector.

36. A method according to claim 33, wherein splitting the scattered radiation comprises dividing the scattered radiation between the first and second detectors in a manner that is substantially independent of a scattering angle and a polarization of the scattered radiation.

37. A method according to claim 36, wherein dividing the scattered radiation comprises passing the scattered radiation through an integrating sphere, having first and second exit ports that are coupled to convey the scattered radiation to the first and second detectors, respectively.

38. A method according to claim 37, wherein the first exit port is substantially larger than the second exit port.

39. A method according to claim 24, wherein configuring at least the first and second detectors comprises spatially filtering the scattered radiation so as to block a portion of the scattered radiation from reaching the first and second detectors, in order to facilitate detection of the radiation that is scattered from the defects.

40. A method according to claim 39, wherein spatially filtering the scattered radiation comprises filtering the radiation using first and second spatial filters, which are respectively positioned so that the first spatial filter filters the scattered radiation reaching the first

detector, while the second spatial filter filters the scattered radiation reaching the second detector.

41. A method according to claim 40, wherein filtering the radiation comprises independently controlling each of the first and second spatial filters, so as to alter the portion of the scattered radiation that is blocked by each of the spatial filters.

42. A method according to claim 24, wherein configuring at least the first and second detectors comprises variably attenuating an intensity of the scattered radiation that reaches at least one of the first and second detectors.

43. A method according to claim 24, wherein configuring at least the first and second detectors comprises configuring a third detector to receive the scattered radiation and to generate a third output responsive thereto, wherein the sensitivity of the third detector is intermediate the sensitivity of the first and second detectors, and processing at least the first and second outputs comprises processing the third output together with the first and second outputs.

44. A method according to claim 24, wherein the optical radiation comprises coherent radiation, and configuring at least the first and second detectors comprises configuring an optical system so that the detectors receive the scattered radiation in a dark-field mode.

45. A method according to claim 44, wherein the sample comprises a semiconductor wafer on which a pattern is formed, and wherein processing at least the first and

second outputs comprises mapping the locations of the defects in the pattern.

46. A method for processing radiation, comprising:

collecting the radiation in an integrating sphere; and

coupling first and second detectors to respective first and second output ports of the integrating sphere, the first port having a substantially greater diameter than the second port, whereby a substantially greater portion of the radiation is conveyed to the first detector than to the second detector.